SEQUENCE LISTING

<110>   Rudert, Fritz
          Ge, Liming
          Ilag, Vic

<120> Novel method and phage for the identification of
      nucleic acid sequences encoding members of a multimeric
      (poly)peptide complex

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<150> PCT/EP98/04836
<151> 1998-08-03

<150> EP 97 11 3319.4
<151> 1997-08-01

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<170> PatentIn Ver. 2.1 + PatentIn Ver. 2.0 + WordPad

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<223> Description of Artificial Sequence: C-terminus of gene II
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Ser Asn Gly Gln Thr Lys Ser Thr Arg Ser Gln Asn Trp Glu S r Thr
        35                  40                  45
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```
Val Thr Trp Asn Glu Thr Ser Arg His Arg Thr Leu Val Ala Tyr Leu
    50                  55                  60
```

```
Lys His Val Glu Leu Gln His Gln Ile Gln Gln Leu Ser Ser Lys Pro
65                  70                  75                  80
```

```
Ser Ala Lys Met Thr Ser Tyr Gln Lys Glu Gln Leu Lys Val Leu Ser
                85                  90                  95
```

```
Asn Pro Asp Leu Leu Glu Phe Ala Ser Gly Leu Val Arg Phe Glu Ala
            100                 105                 110
```

```
Arg Ile Glu Thr Arg Tyr Leu Lys Ser Phe Gly Leu Pro Leu Asn Leu
            115                 120                 125
```

```
Phe Asp Ala Ile Arg Phe Ala Ser Asp Tyr Asn Arg Gln Gly Lys Asp
    130                 135                 140
```

```
Leu Ile Phe Asp Leu Trp Ser Phe Ser Phe Ser Glu Leu Phe Lys Ala
145                 150                 155                 160
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Phe Glu Gly Asp Ser Met Asn Ile Tyr Asp Asp Ser Ala Val Leu Asp
            165                 170                 175
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Ala Ile Gln Ser Lys His Phe Thr Ile Thr Pro Ser Gly Lys Thr Ser
            180                 185                 190
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Phe Ala Lys Ala Ser Arg Tyr Phe Gly Phe Tyr Arg Arg Leu Val Asn
    195                 200                 205
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```
Glu Gly Tyr Asp Ser Val Ala Leu Thr Met Pro Arg Asn Ser Phe Trp
    210                 215                 220
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```
Arg Tyr Val Ser Ala Leu Val Glu Cys Gly Ile Pro Lys Ser Gln Leu
225                 230                 235                 240
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```
Met Asn Leu Ser Thr Cys Asn Asn Val Val Pro Leu Val Arg Phe Ile
                245                 250                 255
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<210> 5
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<223> Description of Artificial Sequence: gene X protein
      encoded by phage vector fhag1A (circular)

<400> 5
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His Phe Thr Ile Thr Pro Ser Gly Lys Thr Ser Phe Ala Lys Ala Ser
                20                  25                  30
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Arg Tyr Phe Gly Phe Tyr Arg Arg Leu Val Asn Glu Gly Tyr Asp Ser
        35                  40                  45
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Val Ala Leu Thr Met Pro Arg Asn Ser Phe Trp Arg Tyr Val Ser Ala
    50              55              60

Leu Val Glu Cys Gly Ile Pro Lys Ser Gln Leu Met Asn Leu Ser Thr
65              70              75              80

Cys Asn Asn Val Val Pro Leu Val Arg Phe Ile Asn Val Asp Phe Ser
            85              90              95

Ser Gln Arg Pro Asp Trp Tyr Asn Glu Pro Val Leu Lys Ile Ala
            100             105             110
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<210> 6
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<223> Description of Artificial Sequence: gene V protein
       encoded by phage vector fhag1A (circular)

<400> 6
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 1               5              10              15

Ser Gly Val Ser Arg Gln Gly Lys Pro Tyr Ser Leu Asn Glu Gln Leu
            20              25              30

Cys Tyr Val Asp Leu Gly Asn Glu Tyr Pro Val Leu Val Lys Ile Thr
        35              40              45

Leu Asp Glu Gly Gln Pro Ala Tyr Ala Pro Gly Leu Tyr Thr Val His
    50              55              60

Leu Ser Ser Phe Lys Val Gly Gln Phe Gly Ser Leu Met Ile Asp Arg
65              70              75              80

Leu Arg Leu Val Pro Ala Lys
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<210> 7
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<212> PRT
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<223> Description of Artificial Sequence: gene VII protein
       encoded by phage vector fhag1A (circular)

<400> 7
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Met Glu Gln Val Ala Asp Phe Asp Thr Ile Tyr Gln Ala Met Ile Gln
 1               5              10              15

Ile Ser Val Val Leu Cys Phe Ala Leu Gly Ile Ile Ala Gly Gly Gln
            20              25              30

Arg
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<210> 8
<211> 36
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene IX protein

encoded by phage vector fhag1A (circular)

<400> 8
Met Ser Val Leu Val Tyr Ser Phe Ala Ser Phe Val Leu Gly Trp Cys
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Leu Arg Ser Gly Ile Thr Tyr Phe Thr Arg Leu Met Glu Thr Ser Ser
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Cys Val Ser Leu
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<210> 9
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<223> Description of Artificial Sequence: gene VIII protein
      encoded by phage vector fhag1A (circular)

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Val Pro Met Leu Ser Phe Ala Ala Glu Gly Asp Asp Pro Ala Lys Ala
                20   25   30

Ala Phe Asp Ser Leu Gln Ala Ser Ala Thr Glu Tyr Ile Gly Tyr Ala
            35   40   45

Trp Ala Met Val Val Val Ile Val Gly Ala Thr Ile Gly Ile Lys Leu
    50   55   60

Phe Lys Lys Phe Thr Ser Lys Ala Ser
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<210> 10
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      encoded by phage vector fhag1A (circular)

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His Arg Lys Glu His Phe Glu Ala Phe Gln Ser Val Ala Gln Cys Thr
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Tyr Asn Gln Thr Val Gln Leu Asp Ile Thr Ala Phe Leu Lys Thr Val
            35   40   45

Lys Lys Asn Lys His Lys Phe Tyr Pro Ala Phe Ile His Ile Leu Ala
    50   55   60

Arg Leu Met Asn Ala His Pro Glu Phe Arg Met Ala Met Lys Asp Gly
65   70   75   80

Glu Leu Val Ile Trp Asp Ser Val His Pro Cys Tyr Thr Val Phe His
                85   90   95

Glu Gln Thr Glu Thr Phe Ser Ser Leu Trp Ser Glu Tyr His Asp Asp

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    Ala Asn Met Asp Asn Phe Phe Ala Pro Val Phe Thr Met Gly Lys Tyr
                    165                 170                 175

    Tyr Thr Gln Gly Asp Lys Val Leu Met Pro Leu Ala Ile Gln Val His
                180                 185                 190

    His Ala Val Cys Asp Gly Phe His Val Gly Arg Met Leu Asn Glu Leu
                195                 200                 205

    Gln Gln Tyr Cys Asp Glu Trp Gln Gly Gly Ala
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<210> 11
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<223> Description of Artificial Sequence: ompA-FLAG-scFv (anti-
     HAG)-gene IIIss encoded by phage vector fhag1A (circular)

<400> 11
Met Lys Lys Thr Ala Ile Ala Ile Ala Val Ala Leu Ala Gly Phe Ala
  1               5                   10                  15

Thr Val Ala Gln Ala Asp Tyr Lys Asp Ile Val Met Thr Gln Ser Pro
            20                  25                  30

Ser Ser Leu Thr Val Thr Ala Gly Glu Lys Val Thr Met Ser Cys Thr
        35                  40                  45

Ser Ser Gln Ser Leu Phe Asn Ser Gly Lys Gln Lys Asn Tyr Leu Thr
    50                  55                  60

Trp Tyr Gln Gln Lys Pro Gly Gln Pro Pro Lys Val Leu Ile Tyr Trp
65                  70                  75                  80

Ala Ser Thr Arg Glu Ser Gly Val Pro Asp Arg Phe Thr Gly Ser Gly
                85                  90                  95

Ser Gly Thr Asp Phe Thr Leu Thr Ile Ser Ser Val Gln Ala Glu Asp
            100                 105                 110

Leu Ala Val Tyr Tyr Cys Gln Asn Asp Tyr Ser Asn Pro Leu Thr Phe
            115                 120                 125

Gly Gly Gly Thr Lys Leu Glu Leu Lys Arg Ala Gly Gly Gly Gly Ser
    130                 135                 140

Gly Gly Gly Gly Ser Gly Gly Gly Gly Ser Gly Gly Gly Ser Gly
145                 150                 155                 160

Gly Gly Gly Ser Gly Gly Gly Gly Ser Glu Val Gln Leu Val Glu Ser
```

```
                165                        170                        175
    Gly Gly Asp Leu Val Lys Pro Gly Gly Ser Leu Lys Leu Ser Cys Ala
                180                        185                190

    Ala Ser Gly Phe Ser Phe Ser Ser Tyr Gly Met Ser Trp Val Arg Gln
                195                200                        205

    Thr Pro Asp Lys Arg Leu Glu Trp Val Ala Thr Ile Ser Asn Gly Gly
            210                    215                220

    Gly Tyr Thr Tyr Tyr Pro Asp Ser Val Lys Gly Arg Phe Thr Ile Ser
    225                    230                235                    240

    Arg Asp Asn Ala Lys Asn Thr Leu Tyr Leu Gln Met Ser Ser Leu Lys
                    245                250                    255

    Ser Glu Asp Ser Ala Met Tyr Tyr Cys Ala Arg Arg Glu Arg Tyr Asp
                260                    265                270

    Glu Asn Gly Phe Ala Tyr Trp Gly Gln Gly Thr Leu Val Thr Val Ser
                275                280                285

    Ala Ser Gly Glu Phe Glu Ala Ser Gly Ala Glu Gly Gly Gly Ser Gly
        290                    295                300

    Ser Gly Asp Phe Asp Tyr Glu Lys Met Ala Asn Ala Asn Lys Gly Ala
    305                    310                315                    320

    Met Thr Glu Asn Ala Asp Glu Asn Ala Leu Gln Ser Asp Ala Lys Gly
                    325                330                    335

    Lys Leu Asp Ser Val Ala Thr Asp Tyr Gly Ala Ala Ile Asp Gly Phe
                340                    345                350

    Ile Gly Asp Val Ser Gly Leu Ala Asn Gly Asn Gly Ala Thr Gly Asp
            355                360                365

    Phe Ala Gly Ser Asn Ser Gln Met Ala Gln Val Gly Asp Gly Asp Asn
        370                    375                380

    Ser Pro Leu Met Asn Asn Phe Arg Gln Tyr Leu Pro Ser Leu Pro Gln
    385                    390                395                    400

    Ser Val Glu Cys Arg Pro Phe Val Phe Gly Ala Gly Lys Pro Tyr Glu
                    405                410                    415

    Phe Ser Ile Asp Cys Asp Lys Ile Asn Leu Phe Arg Gly Val Phe Ala
                420                    425                430

    Phe Leu Leu Tyr Val Ala Thr Phe Met Tyr Val Phe Ser Thr Phe Ala
            435                    440                445

    Asn Ile Leu Arg Asn Lys Glu Ser
        450                455
```

<210> 12
<211> 112
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene VI protein
      encoded by phage vector fhag1A (circular)

<400> 12
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Met Pro Val Leu Leu Gly Ile Pro Leu Leu Leu Arg Phe Leu Gly Phe
  1               5                10                15

Leu Leu Val Thr Leu Phe Gly Tyr Leu Leu Thr Phe Leu Lys Lys Gly
             20              25              30

Ph  Gly Lys Ile Ala Ile Ala Ile Ser Leu Phe Leu Ala Leu Ile Ile
         35              40              45

Gly Leu Asn Ser Ile Leu Val Gly Tyr Leu Ser Asp Ile Ser Ala Gln
     50              55              60

Leu Pro Ser Asp Phe Val Gln Gly Val Gln Leu Ile Leu Pro Ser Asn
 65              70              75              80

Ala Leu Pro Cys Phe Tyr Val Ile Leu Ser Val Lys Ala Ala Ile Phe
             85              90              95

Ile Phe Asp Val Lys Gln Lys Ile Val Ser Tyr Leu Asp Trp Asp Lys
            100             105             110
```

<210> 13
<211> 348
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene I protein
      encoded by phage vector fhag1A (circular)

<400> 13
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Met Ala Val Tyr Phe Val Thr Gly Lys Leu Gly Ser Gly Lys Thr Leu
  1               5                10                15

Val Ser Val Gly Lys Ile Gln Asp Lys Ile Val Ala Gly Cys Lys Ile
             20              25              30

Ala Thr Asn Leu Asp Leu Arg Leu Gln Asn Leu Pro Gln Val Gly Arg
         35              40              45

Phe Ala Lys Thr Pro Arg Val Leu Arg Ile Pro Asp Lys Pro Ser Ile
     50              55              60

Ser Asp Leu Leu Ala Ile Gly Arg Gly Asn Asp Ser Tyr Asp Glu Asn
 65              70              75              80

Lys Asn Gly Leu Leu Val Leu Asp Glu Cys Gly Thr Trp Phe Asn Thr
             85              90              95

Arg Ser Trp Asn Asp Lys Glu Arg Gln Pro Ile Ile Asp Trp Phe Leu
            100             105             110

His Ala Arg Lys Leu Gly Trp Asp Ile Ile Phe Leu Val Gln Asp Leu
            115             120             125

Ser Ile Val Asp Lys Gln Ala Arg Ser Ala Leu Ala Glu His Val Val
    130             135             140

Tyr Cys Arg Arg Leu Asp Arg Ile Thr Leu Pro Phe Val Gly Thr Leu
145             150             155             160

Tyr Ser Leu Val Thr Gly Ser Lys Met Pro Leu Pro Lys Leu His Val
```

```
                165                    170                    175

   Gly Val Val Lys Tyr Gly Asp Ser Gln Leu Ser Pro Thr Val Glu Arg
               180                185                190

   Trp Leu Tyr Thr Gly Lys Asn Leu Tyr Asn Ala Tyr Asp Thr Lys Gln
               195                200                205

   Ala Phe Ser Ser Asn Tyr Asp Ser Gly Val Tyr Ser Tyr Leu Thr Pro
       210                215                220

   Tyr Leu Ser His Gly Arg Tyr Phe Lys Pro Leu Asn Leu Gly Gln Lys
   225                230                235                240

   Met Lys Leu Thr Lys Ile Tyr Leu Lys Lys Phe Ser Arg Val Leu Cys
               245                250                255

   Leu Ala Ile Gly Phe Ala Ser Ala Phe Thr Tyr Ser Tyr Ile Thr Gln
               260                265                270

   Pro Lys Pro Glu Val Lys Lys Val Val Ser Gln Thr Tyr Asp Phe Asp
               275                280                285

   Lys Phe Thr Ile Asp Ser Ser Gln Arg Leu Asn Leu Ser Tyr Arg Tyr
       290                295                300

   Val Phe Lys Asp Ser Lys Gly Lys Leu Ile Asn Ser Asp Asp Leu Gln
   305                310                315                320

   Lys Gln Gly Tyr Ser Ile Thr Tyr Ile Asp Leu Cys Thr Val Ser Ile
               325                330                335

   Lys Lys Gly Asn Ser Asn Glu Ile Val Lys Cys Asn
               340                345
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<210> 14
<211> 426
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene IV protein
      encoded by phage vector fhag1A (circular)

<400> 14

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   Met Lys Leu Leu Asn Val Ile Asn Phe Val Phe Leu Met Phe Val Ser
   1               5                10                15

   Ser Ser Ser Phe Ala Gln Val Ile Glu Met Asn Asn Ser Pro Leu Arg
               20                25                30

   Asp Phe Val Thr Trp Tyr Ser Lys Gln Thr Gly Glu Ser Val Ile Val
               35                40                45

   Ser Pro Asp Val Lys Gly Thr Val Thr Val Tyr Ser Ser Asp Val Lys
       50                55                60

   Pro Glu Asn Leu Arg Asn Phe Phe Ile Ser Val Leu Arg Ala Asn Asn
   65                70                75                80

   Phe Asp Met Val Gly Ser Ile Pro Ser Ile Ile Gln Lys Tyr Asn Pro
               85                90                95

   Asn Ser Gln Asp Tyr Ile Asp Glu Leu Pro Ser Ser Asp Ile Gln Glu
```

```
            100                    105                    110

Tyr Asp Asp Asn Ser Ala Pro Ser Gly Gly Phe Phe Val Pro Gln Asn
        115                 120                 125

Asp Asn Val Thr Gln Thr Phe Lys Ile Asn Asn Val Arg Ala Lys Asp
        130                 135                 140

Leu Ile Arg Val Val Glu Leu Phe Val Lys Ser Asn Thr Ser Lys Ser
145                 150                 155                 160

Ser Asn Val Leu Ser Val Asp Gly Ser Asn Leu Leu Val Val Ser Ala
                165                 170                 175

Pro Lys Asp Ile Leu Asp Asn Leu Pro Gln Phe Leu Ser Thr Val Asp
            180                 185                 190

Leu Pro Thr Asp Gln Ile Leu Ile Glu Gly Leu Ile Phe Glu Val Gln
            195                 200                 205

Gln Gly Asp Ala Leu Asp Phe Ser Phe Ala Ala Gly Ser Gln Arg Gly
    210                 215                 220

Thr Val Ala Gly Gly Val Asn Thr Asp Arg Leu Thr Ser Val Leu Ser
225                 230                 235                 240

Ser Ala Gly Gly Ser Phe Gly Ile Phe Asn Gly Asp Val Leu Gly Leu
                245                 250                 255

Ser Val Arg Ala Leu Lys Thr Asn Ser His Ser Lys Ile Leu Ser Val
            260                 265                 270

Pro Arg Ile Leu Thr Leu Ser Gly Gln Lys Gly Ser Ile Ser Val Gly
            275                 280                 285

Gln Asn Val Pro Phe Ile Thr Gly Arg Val Thr Gly Glu Ser Ala Asn
    290                 295                 300

Val Asn Asn Pro Phe Gln Thr Val Glu Arg Gln Asn Val Gly Ile Ser
305                 310                 315                 320

Met Ser Val Phe Pro Val Ala Met Ala Gly Gly Asn Ile Val Leu Asp
            325                 330                 335

Ile Thr Ser Lys Ala Asp Ser Leu Ser Ser Ser Thr Gln Ala Ser Asp
            340                 345                 350

Val Ile Thr Asn Gln Arg Ser Ile Ala Thr Thr Val Asn Leu Arg Asp
            355                 360                 365

Gly Gln Thr Leu Leu Leu Gly Gly Leu Thr Asp Tyr Lys Asn Thr Ser
    370                 375                 380

Gln Asp Ser Gly Val Pro Phe Leu Ser Lys Ile Pro Leu Ile Gly Leu
385                 390                 395                 400

Leu Phe Ser Ser Arg Ser Asp Ser Asn Glu Glu Ser Thr Leu Tyr Val
                405                 410                 415

Leu Val Lys Ala Thr Ile Val Arg Ala Leu
            420                 425
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```
<210> 15
<211> 134
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: N-terminus of gene II
      protein encoded by phage vector fhag1A (circular)

<400> 15
Met Ile Asp Met Leu Val Leu Arg Leu Pro Phe Ile Asp Ser Leu Val
  1               5                  10                  15

Cys Ser Arg Leu Ser Gly Asn Asp Leu Ile Ala Phe Val Asp Leu Ser
             20                  25                  30

Lys Ile Ala Thr Leu Ser Gly Met Asn Leu Ser Ala Arg Thr Val Glu
         35                  40                  45

Tyr His Ile Asp Gly Asp Leu Thr Val Ser Gly Leu Ser His Pro Phe
     50                  55                  60

Glu Ser Leu Pro Thr His Tyr Ser Gly Ile Ala Phe Lys Ile Tyr Glu
 65                  70                  75                  80

Gly Ser Lys Asn Phe Tyr Pro Cys Val Glu Ile Lys Ala Ser Pro Ala
                 85                  90                  95

Lys Val Leu Gln Gly His Asn Val Phe Gly Thr Thr Asp Leu Ala Leu
                100                 105                 110

Cys Ser Glu Ala Leu Leu Leu Asn Phe Ala Asn Ser Leu Pro Cys Leu
         115                 120                 125

Tyr Asp Leu Leu Asp Val
    130
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<210> 16
<211> 33
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: primer gIII short(for)

<400> 16
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```
<210> 17
<211> 32
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: primer gIII short(rev)

<400> 17
cccccccaag cttatcaaga ctccttatta cg                           32
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<210> 18
<211> 7055
<212> DNA
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<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: phage vector fjun_1B
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<220>
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<223> gene X

<220>
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<223> gene VII

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<220>
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<223> jun peptide

<220>
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<223> gene III C-terminal domain

<220>
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<223> gene VI

<220>
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<223> gene I

<220>
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<222> (4868)..(6145)
<223> gene IV

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<222> (6654)..(7055)
<223> N-terminus gene II

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<220>
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<222> (2522)..(2556)
<223> lac operator

<220>
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<223> packaging signal

<220>
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<223> fd ori

<220>
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<223> fd terminator

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cgttcgcaga attgggaatc aactgttaca tggaatgaaa cttccagaca ccgtacttta 180
gttgcatatt taaaacatgt tgaactacag caccagattc agcaattaag ctctaagcca 240
tccgcaaaaa tgacctctta tcaaaaggag caattaaagg tactgtctaa tcctgacctg 300
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atgtttttgg tacaaccgat ttagctttat gctctgaggc tttattgctt aattttgcta 7020
actctctgcc ttgcttgtac gatttattgg atgtt               7055
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<210> 19
<211> 276
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: C-terminus of gene II
      protein encoded by phage vector fjun_1B (circular)

<400> 19
Asn Ala Thr Thr Ile Ser Arg Ile Asp Ala Thr Phe Ser Ala Arg Ala
1   5   10   15

Pro Asn Glu Asn Ile Ala Lys Gln Val Ile Asp His Leu Arg Asn Val

```
                20                          25                          30

Ser Asn Gly Gln Thr Lys Ser Thr Arg Ser Gln Asn Trp Glu Ser Thr
            35                  40                  45

Val Thr Trp Asn Glu Thr Ser Arg His Arg Thr Leu Val Ala Tyr Leu
        50                  55                  60

Lys His Val Glu Leu Gln His Gln Ile Gln Gln Leu Ser Ser Lys Pro
65                  70                  75                      80

Ser Ala Lys Met Thr Ser Tyr Gln Lys Glu Gln Leu Lys Val Leu Ser
                85                  90                  95

Asn Pro Asp Leu Leu Glu Phe Ala Ser Gly Leu Val Arg Phe Glu Ala
            100             105             110

Arg Ile Glu Thr Arg Tyr Leu Lys Ser Phe Gly Leu Pro Leu Asn Leu
        115             120             125

Phe Asp Ala Ile Arg Phe Ala Ser Asp Tyr Asn Arg Gln Gly Lys Asp
    130             135             140

Leu Ile Phe Asp Leu Trp Ser Phe Ser Phe Ser Glu Leu Phe Lys Ala
145             150             155                     160

Phe Glu Gly Asp Ser Met Asn Ile Tyr Asp Asp Ser Ala Val Leu Asp
            165             170             175

Ala Ile Gln Ser Lys His Phe Thr Ile Thr Pro Ser Gly Lys Thr Ser
            180             185             190

Phe Ala Lys Ala Ser Arg Tyr Phe Gly Phe Tyr Arg Arg Leu Val Asn
        195             200             205

Glu Gly Tyr Asp Ser Val Ala Leu Thr Met Pro Arg Asn Ser Phe Trp
    210             215             220

Arg Tyr Val Ser Ala Leu Val Glu Cys Gly Ile Pro Lys Ser Gln Leu
225             230             235                     240

Met Asn Leu Ser Thr Cys Asn Asn Val Val Pro Leu Val Arg Phe Ile
            245             250             255

Asn Val Asp Phe Ser Ser Gln Arg Pro Asp Trp Tyr Asn Glu Pro Val
            260             265             270

Leu Lys Ile Ala
        275
```

<210> 20
<211> 111
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene X protein
      encoded by phage vector fjun_1B (circular)

<400> 20

```
Met Asn Ile Tyr Asp Asp Ser Ala Val Leu Asp Ala Ile Gln Ser Lys
1               5                   10                  15

His Phe Thr Ile Thr Pro Ser Gly Lys Thr Ser Phe Ala Lys Ala Ser
```

```
                    20                      25                      30

        Arg Tyr Phe Gly Phe Tyr Arg Arg Leu Val Asn Glu Gly Tyr Asp Ser
                35                      40                      45

        Val Ala Leu Thr Met Pro Arg Asn Ser Phe Trp Arg Tyr Val Ser Ala
                50                      55                      60

        Leu Val Glu Cys Gly Ile Pro Lys Ser Gln Leu Met Asn Leu Ser Thr
        65                      70                      75                      80

        Cys Asn Asn Val Val Pro Leu Val Arg Phe Ile Asn Val Asp Phe Ser
                        85                      90                      95

        Ser Gln Arg Pro Asp Trp Tyr Asn Glu Pro Val Leu Lys Ile Ala
                100                     105                     110
```

```
<210> 21
<211> 87
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene V protein
      encoded by phage vector fjun_1B (circular)

<400> 21
Met Ile Lys Val Glu Ile Lys Pro Ser Gln Ala Gln Phe Thr Thr Arg
1               5                   10                  15

Ser Gly Val Ser Arg Gln Gly Lys Pro Tyr Ser Leu Asn Glu Gln Leu
            20                  25                  30

Cys Tyr Val Asp Leu Gly Asn Glu Tyr Pro Val Leu Val Lys Ile Thr
        35                  40                  45

Leu Asp Glu Gly Gln Pro Ala Tyr Ala Pro Gly Leu Tyr Thr Val His
        50                  55                  60

Leu Ser Ser Phe Lys Val Gly Gln Phe Gly Ser Leu Met Ile Asp Arg
65                  70                  75                  80

Leu Arg Leu Val Pro Ala Lys
                85
```

```
<210> 22
<211> 33
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene VII protein
      encoded by phage vector fjun_1B (circular)

<400> 22
Met Glu Gln Val Ala Asp Phe Asp Thr Ile Tyr Gln Ala Met Ile Gln
1               5                   10                  15

Ile Ser Val Val Leu Cys Phe Ala Leu Gly Ile Ile Ala Gly Gly Gln
            20                  25                  30

Arg
```

```
<210> 23
```

```
<211> 36
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene IX protein
      encoded by phage vector fjun_1B (circular)

<400> 23
Met Ser Val Leu Val Tyr Ser Phe Ala Ser Phe Val Leu Gly Trp Cys
 1               5                  10                  15

Leu Arg Ser Gly Ile Thr Tyr Phe Thr Arg Leu Met Glu Thr Ser Ser
            20                  25                  30

Cys Val Ser Leu
        35


<210> 24
<211> 73
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene VIII protein
      encoded by phage vector fjun_1B (circular)

<400> 24
Met Arg Lys Ser Leu Val Leu Lys Ala Ser Val Ala Val Ala Thr Leu
 1               5                  10                  15

Val Pro Met Leu Ser Phe Ala Ala Glu Gly Asp Asp Pro Ala Lys Ala
            20                  25                  30

Ala Phe Asp Ser Leu Gln Ala Ser Ala Thr Glu Tyr Ile Gly Tyr Ala
        35                  40                  45

Trp Ala Met Val Val Val Ile Val Gly Ala Thr Ile Gly Ile Lys Leu
    50                  55                  60

Phe Lys Lys Phe Thr Ser Lys Ala Ser
65                  70


<210> 25
<211> 219
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: cat protein
      encoded by phage vector fjun_1B (circular)

<400> 25
Met Glu Lys Lys Ile Thr Gly Tyr Thr Thr Val Asp Ile Ser Gln Trp
 1               5                  10                  15

His Arg Lys Glu His Phe Glu Ala Phe Gln Ser Val Ala Gln Cys Thr
            20                  25                  30

Tyr Asn Gln Thr Val Gln Leu Asp Ile Thr Ala Phe Leu Lys Thr Val
        35                  40                  45

Lys Lys Asn Lys His Lys Phe Tyr Pro Ala Phe Ile His Ile Leu Ala
    50                  55                  60

Arg Leu Met Asn Ala His Pro Glu Phe Arg Met Ala Met Lys Asp Gly
65                  70                  75                  80
```

```
Glu Leu Val Ile Trp Asp Ser Val His Pro Cys Tyr Thr Val Phe His
                85                  90                  95

Glu Gln Thr Glu Thr Phe Ser Ser Leu Trp Ser Glu Tyr His Asp Asp
            100             105             110

Phe Arg Gln Phe Leu His Ile Tyr Ser Gln Asp Val Ala Cys Tyr Gly
        115             120             125

Glu Asn Leu Ala Tyr Phe Pro Lys Gly Phe Ile Glu Asn Met Phe Phe
    130             135             140

Val Ser Ala Asn Pro Trp Val Ser Phe Thr Ser Phe Asp Leu Asn Val
145             150             155             160

Ala Asn Met Asp Asn Phe Phe Ala Pro Val Phe Thr Met Gly Lys Tyr
            165             170             175

Tyr Thr Gln Gly Asp Lys Val Leu Met Pro Leu Ala Ile Gln Val His
            180             185             190

His Ala Val Cys Asp Gly Phe His Val Gly Arg Met Leu Asn Glu Leu
        195             200             205

Gln Gln Tyr Cys Asp Glu Trp Gln Gly Gly Ala
    210             215
```

<210> 26
<211> 266
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: ompA-FLAG-jun peptide-
      gene IIIc encoded by phage vector fjun_1B (circular)

<400> 26

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Met Lys Lys Thr Ala Ile Ala Ile Ala Val Ala Leu Ala Gly Phe Ala
  1               5                  10                  15

Thr Val Ala Gln Ala Asp Tyr Lys Asp Val Asp Ala Gly Gly Arg Ile
            20              25              30

Ala Arg Leu Glu Glu Lys Val Lys Thr Leu Lys Ala Gln Asn Ser Glu
        35              40              45

Leu Ala Ser Thr Ala Asn Met Leu Arg Glu Gln Val Ala Gln Leu Lys
    50              55              60

Gln Lys Val Met Asn His Gly Gly Ala Glu Phe Asn Ala Gly Gly Gly
65              70              75              80

Ser Gly Gly Gly Ser Gly Gly Gly Ser Glu Gly Gly Gly Ser Glu Gly
            85              90              95

Gly Gly Ser Glu Gly Gly Gly Ser Glu Gly Gly Gly Ser Gly Gly Gly
            100             105             110

Ser Gly Ser Gly Asp Phe Asp Tyr Glu Lys Met Ala Asn Ala Asn Lys
        115             120             125

Gly Ala Met Thr Glu Asn Ala Asp Glu Asn Ala Leu Gln Ser Asp Ala
    130             135             140
```

```
Lys Gly Lys Leu Asp Ser Val Ala Thr Asp Tyr Gly Ala Ala Ile Asp
145             150             155                 160

Gly Phe Ile Gly Asp Val Ser Gly Leu Ala Asn Gly Asn Gly Ala Thr
                165             170             175

Gly Asp Phe Ala Gly Ser Asn Ser Gln Met Ala Gln Val Gly Asp Gly
            180             185             190

Asp Asn Ser Pro Leu Met Asn Asn Phe Arg Gln Tyr Leu Pro Ser Leu
            195             200             205

Pro Gln Ser Val Glu Cys Arg Pro Phe Val Phe Ser Ala Gly Lys Pro
        210             215             220

Tyr Glu Phe Ser Ile Asp Cys Asp Lys Ile Asn Leu Phe Arg Gly Val
225             230             235                 240

Phe Ala Phe Leu Leu Tyr Val Ala Thr Phe Met Tyr Val Phe Ser Thr
                245             250             255

Phe Ala Asn Ile Leu Arg Asn Lys Glu Ser
            260             265


<210> 27
<211> 112
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene VI protein
      encoded by phage vector fjun_1B (circular)

<400> 27
Met Pro Val Leu Leu Gly Ile Pro Leu Leu Leu Arg Phe Leu Gly Phe
  1             5                 10                  15

Leu Leu Val Thr Leu Phe Gly Tyr Leu Leu Thr Phe Leu Lys Lys Gly
            20              25              30

Phe Gly Lys Ile Ala Ile Ala Ile Ser Leu Phe Leu Ala Leu Ile Ile
        35              40              45

Gly Leu Asn Ser Ile Leu Val Gly Tyr Leu Ser Asp Ile Ser Ala Gln
    50              55              60

Leu Pro Ser Asp Phe Val Gln Gly Val Gln Leu Ile Leu Pro Ser Asn
65              70              75                  80

Ala Leu Pro Cys Phe Tyr Val Ile Leu Ser Val Lys Ala Ala Ile Phe
                85              90                  95

Ile Phe Asp Val Lys Gln Lys Ile Val Ser Tyr Leu Asp Trp Asp Lys
            100             105             110


<210> 28
<211> 348
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene I protein
      encoded by phage vector fjun_1B (circular)
```

```
<400> 28
Met Ala Val Tyr Phe Val Thr Gly Lys Leu Gly Ser Gly Lys Thr Leu
1               5                   10                  15

Val Ser Val Gly Lys Ile Gln Asp Lys Ile Val Ala Gly Cys Lys Ile
                20              25                  30

Ala Thr Asn Leu Asp Leu Arg Leu Gln Asn Leu Pro Gln Val Gly Arg
            35                  40                  45

Phe Ala Lys Thr Pro Arg Val Leu Arg Ile Pro Asp Lys Pro Ser Ile
        50                  55                  60

Ser Asp Leu Leu Ala Ile Gly Arg Gly Asn Asp Ser Tyr Asp Glu Asn
65                  70                  75                  80

Lys Asn Gly Leu Leu Val Leu Asp Glu Cys Gly Thr Trp Phe Asn Thr
                85                  90                  95

Arg Ser Trp Asn Asp Lys Glu Arg Gln Pro Ile Ile Asp Trp Phe Leu
            100                 105                 110

His Ala Arg Lys Leu Gly Trp Asp Ile Ile Phe Leu Val Gln Asp Leu
        115                 120                 125

Ser Ile Val Asp Lys Gln Ala Arg Ser Ala Leu Ala Glu His Val Val
    130                 135                 140

Tyr Cys Arg Arg Leu Asp Arg Ile Thr Leu Pro Phe Val Gly Thr Leu
145                 150                 155                 160

Tyr Ser Leu Val Thr Gly Ser Lys Met Pro Leu Pro Lys Leu His Val
                165                 170                 175

Gly Val Val Lys Tyr Gly Asp Ser Gln Leu Ser Pro Thr Val Glu Arg
            180                 185                 190

Trp Leu Tyr Thr Gly Lys Asn Leu Tyr Asn Ala Tyr Asp Thr Lys Gln
        195                 200                 205

Ala Phe Ser Ser Asn Tyr Asp Ser Gly Val Tyr Ser Tyr Leu Thr Pro
    210                 215                 220

Tyr Leu Ser His Gly Arg Tyr Phe Lys Pro Leu Asn Leu Gly Gln Lys
225                 230                 235                 240

Met Lys Leu Thr Lys Ile Tyr Leu Lys Lys Phe Ser Arg Val Leu Cys
                245                 250                 255

Leu Ala Ile Gly Phe Ala Ser Ala Phe Thr Tyr Ser Tyr Ile Thr Gln
            260                 265                 270

Pro Lys Pro Glu Val Lys Lys Val Val Ser Gln Thr Tyr Asp Phe Asp
        275                 280                 285

Lys Phe Thr Ile Asp Ser Ser Gln Arg Leu Asn Leu Ser Tyr Arg Tyr
    290                 295                 300

Val Phe Lys Asp Ser Lys Gly Lys Leu Ile Asn Ser Asp Asp Leu Gln
305                 310                 315                 320

Lys Gln Gly Tyr Ser Ile Thr Tyr Ile Asp Leu Cys Thr Val Ser Ile
            325                 330                 335
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Lys Lys Gly Asn Ser Asn Glu Ile Val Lys Cys Asn
       340   345

<210> 29
<211> 426
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene IV protein
      encoded by phage vector fjun_1B (circular)

<400> 29
Met Lys Leu Leu Asn Val Ile Asn Phe Val Phe Leu Met Phe Val Ser
1   5   10   15

Ser Ser Ser Phe Ala Gln Val Ile Glu Met Asn Asn Ser Pro Leu Arg
         20   25   30

Asp Phe Val Thr Trp Tyr Ser Lys Gln Thr Gly Glu Ser Val Ile Val
      35   40   45

Ser Pro Asp Val Lys Gly Thr Val Thr Val Tyr Ser Ser Asp Val Lys
   50   55   60

Pro Glu Asn Leu Arg Asn Phe Phe Ile Ser Val Leu Arg Ala Asn Asn
65   70   75   80

Phe Asp Met Val Gly Ser Ile Pro Ser Ile Ile Gln Lys Tyr Asn Pro
         85   90   95

Asn Ser Gln Asp Tyr Ile Asp Glu Leu Pro Ser Ser Asp Ile Gln Glu
        100   105   110

Tyr Asp Asp Asn Ser Ala Pro Ser Gly Gly Phe Phe Val Pro Gln Asn
        115   120   125

Asp Asn Val Thr Gln Thr Phe Lys Ile Asn Asn Val Arg Ala Lys Asp
    130   135   140

Leu Ile Arg Val Val Glu Leu Phe Val Lys Ser Asn Thr Ser Lys Ser
145   150   155   160

Ser Asn Val Leu Ser Val Asp Gly Ser Asn Leu Leu Val Val Ser Ala
        165   170   175

Pro Lys Asp Ile Leu Asp Asn Leu Pro Gln Phe Leu Ser Thr Val Asp
        180   185   190

Leu Pro Thr Asp Gln Ile Leu Ile Glu Gly Leu Ile Phe Glu Val Gln
        195   200   205

Gln Gly Asp Ala Leu Asp Phe Ser Phe Ala Ala Gly Ser Gln Arg Gly
    210   215   220

Thr Val Ala Gly Gly Val Asn Thr Asp Arg Leu Thr Ser Val Leu Ser
225   230   235   240

Ser Ala Gly Gly Ser Phe Gly Ile Phe Asn Gly Asp Val Leu Gly Leu
        245   250   255

Ser Val Arg Ala Leu Lys Thr Asn Ser His Ser Lys Ile Leu Ser Val
        260   265   270

```
Pro Arg Ile Leu Thr Leu Ser Gly Gln Lys Gly Ser Ile Ser Val Gly
    275                 280                 285

Gln Asn Val Pro Phe Ile Thr Gly Arg Val Thr Gly Glu Ser Ala Asn
    290             295                 300

Val Asn Asn Pro Phe Gln Thr Val Glu Arg Gln Asn Val Gly Ile Ser
305             310                 315                 320

Met Ser Val Phe Pro Val Ala Met Ala Gly Gly Asn Ile Val Leu Asp
            325                 330                 335

Ile Thr Ser Lys Ala Asp Ser Leu Ser Ser Ser Thr Gln Ala Ser Asp
        340                 345                 350

Val Ile Thr Asn Gln Arg Ser Ile Ala Thr Thr Val Asn Leu Arg Asp
        355                 360                 365

Gly Gln Thr Leu Leu Leu Gly Gly Leu Thr Asp Tyr Lys Asn Thr Ser
    370                 375                 380

Gln Asp Ser Gly Val Pro Phe Leu Ser Lys Ile Pro Leu Ile Gly Leu
385                 390                 395                 400

Leu Phe Ser Ser Arg Ser Asp Ser Asn Glu Glu Ser Thr Leu Tyr Val
            405                 410                 415

Leu Val Lys Ala Thr Ile Val Arg Ala Leu
        420                 425


<210> 30
<211> 134
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: N-terminus of gene II
      protein encoded by phage vector fjun_1B (circular)

<400> 30
Met Ile Asp Met Leu Val Leu Arg Leu Pro Phe Ile Asp Ser Leu Val
  1             5                 10                  15

Cys Ser Arg Leu Ser Gly Asn Asp Leu Ile Ala Phe Val Asp Leu Ser
            20                  25                  30

Lys Ile Ala Thr Leu Ser Gly Met Asn Leu Ser Ala Arg Thr Val Glu
        35                  40                  45

Tyr His Ile Asp Gly Asp Leu Thr Val Ser Gly Leu Ser His Pro Phe
    50                  55                  60

Glu Ser Leu Pro Thr His Tyr Ser Gly Ile Ala Phe Lys Ile Tyr Glu
 65                 70                  75                  80

Gly Ser Lys Asn Phe Tyr Pro Cys Val Glu Ile Lys Ala Ser Pro Ala
            85                  90                  95

Lys Val Leu Gln Gly His Asn Val Phe Gly Thr Thr Asp Leu Ala Leu
            100                 105                 110

Cys Ser Glu Ala Leu Leu Leu Asn Phe Ala Asn Ser Leu Pro Cys Leu
        115                 120                 125
```

Tyr Asp Leu Leu Asp Val
    130

<210> 31
<211> 6971
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: phage vector fpep3_1B-IR3seq
      (circular)

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<222> (94)..(429)
<223> gene VI

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<223> gene I

<220>
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<222> (1459)..(2736)
<223> gene IV

<220>
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<222> (3245)..(4474)
<223> gene II

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<222> (4142)..(4474)
<223> gene X

<220>
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<222> (4489)..(4749)
<223> gene V

<220>
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<222> (4754)..(4852)
<223> gene VII

<220>
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<222> (4852)..(4959)
<223> gene IX

<220>
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<222> (4947)..(5165)
<223> gene VIII

<220>
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<222> (5289)..(5945)
<223> cat resistance gene

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<220>
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<222> (6253)..(6969)
<223> ompA-FLAG-pep3-gIIIs

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<223> ompA signal sequence

<220>
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<223> FLAG peptide

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<223> gene IIIs

<220>
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<222> (6140)..(6144)

<220>
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<222> (6163)..(6167)

<220>
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<223> lac operator

<220>
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<222> (2737)..(2815)
<223> packaging signal

<220>
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<222> (3033)..(3149)
<223> f1 ori

<220>
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acatatgatt gacatgctag ttttacgatt accgttcatc gattctcttg tttgctccag 3300
actctcaggc aatgacctga tagcctttttt agacctctca aaaatagcta ccctctccgg 3360
catgaattta tcagctagaa cggttgaata tcatattgat ggtgatttga ctgtctccgg 3420
cctttctcac ccgtttgaat ctttacctac acattactca ggcattgcat ttaaaatata 3480
tgagggttct aaaaattttt atccttgcgt tgaaataaag gcttctcccg caaaagtatt 3540
acagggtcat aatgttttttg gtacaaccga tttagcttta tgctctgagg ctttattgct 3600
taattttgct aattctttgc cttgcctgta tgatttattg gatgttaacg ctactactat 3660
tagtagaatt gatgccacct tttcagctcg cgccccaaat gaaaatatag ctaaacaggt 3720
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ggaatcaact gttacatgga atgaaacttc cagacaccgt actttagttg catatttaaa 3840
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cggtctggtt cgctttgaag ctcgaattaa aacgcgatat ttgaagtctt tcgggcttcc 4020
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```

```
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tatgaatttt ctattgattg tgacaaaata aacttattcc gtggtgtctt tgcgtttctt  6900
ttatatgttg ccacctttat gtatgtattt tctacgtttg ctaacatact gcgtaataag  6960
gagtcttgat a                                                       6971
```

<210> 32
<211> 112
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene VI protein
     encoded by phage vector fpep3_1B-IR3seq (circular)

<400> 32
```
Met Pro Val Leu Leu Gly Ile Pro Leu Leu Leu Arg Phe Leu Gly Phe
 1               5                  10                  15


Leu Leu Val Thr Leu Phe Gly Tyr Leu Leu Thr Phe Leu Lys Lys Gly
            20                  25                  30


Phe Gly Lys Ile Ala Ile Ala Ile Ser Leu Phe Leu Ala Leu Ile Ile
```

```
              35                    40                    45
Gly Leu Asn Ser Ile Leu Val Gly Tyr Leu Ser Asp Ile Ser Ala Gln
      50                    55                    60

Leu Pro Ser Asp Phe Val Gln Gly Val Gln Leu Ile Leu Pro Ser Asn
 65                    70                    75                    80

Ala Leu Pro Cys Phe Tyr Val Ile Leu Ser Val Lys Ala Ala Ile Phe
                85                    90                    95

Ile Phe Asp Val Lys Gln Lys Ile Val Ser Tyr Leu Asp Trp Asp Lys
                100                   105                   110
```

```
<210> 33
<211> 348
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene I protein
      encoded by phage vector fpep3_1B-IR3seq (circular)

<400> 33
Met Ala Val Tyr Phe Val Thr Gly Lys Leu Gly Ser Gly Lys Thr Leu
 1               5                   10                    15

Val Ser Val Gly Lys Ile Gln Asp Lys Ile Val Ala Gly Cys Lys Ile
                20                    25                    30

Ala Thr Asn Leu Asp Leu Arg Leu Gln Asn Leu Pro Gln Val Gly Arg
        35                    40                    45

Phe Ala Lys Thr Pro Arg Val Leu Arg Ile Pro Asp Lys Pro Ser Ile
      50                    55                    60

Ser Asp Leu Leu Ala Ile Gly Arg Gly Asn Asp Ser Tyr Asp Glu Asn
 65                    70                    75                    80

Lys Asn Gly Leu Leu Val Leu Asp Glu Cys Gly Thr Trp Phe Asn Thr
                85                    90                    95

Arg Ser Trp Asn Asp Lys Glu Arg Gln Pro Ile Ile Asp Trp Phe Leu
                100                   105                   110

His Ala Arg Lys Leu Gly Trp Asp Ile Ile Phe Leu Val Gln Asp Leu
        115                   120                   125

Ser Ile Val Asp Lys Gln Ala Arg Ser Ala Leu Ala Glu His Val Val
      130                   135                   140

Tyr Cys Arg Arg Leu Asp Arg Ile Thr Leu Pro Phe Val Gly Thr Leu
145                   150                   155                   160

Tyr Ser Leu Val Thr Gly Ser Lys Met Pro Leu Pro Lys Leu His Val
                165                   170                   175

Gly Val Val Lys Tyr Gly Asp Ser Gln Leu Ser Pro Thr Val Glu Arg
                180                   185                   190

Trp Leu Tyr Thr Gly Lys Asn Leu Tyr Asn Ala Tyr Asp Thr Lys Gln
        195                   200                   205

Ala Phe Ser Ser Asn Tyr Asp Ser Gly Val Tyr Ser Tyr Leu Thr Pro
```

```
        210                    215                    220

Tyr Leu Ser His Gly Arg Tyr Phe Lys Pro Leu Asn Leu Gly Gln Lys
225                 230                 235                 240

Met Lys Leu Thr Lys Ile Tyr Leu Lys Lys Phe Ser Arg Val Leu Cys
                245                 250                 255

Leu Ala Ile Gly Phe Ala Ser Ala Phe Thr Tyr Ser Tyr Ile Thr Gln
                260                 265                 270

Pro Lys Pro Glu Val Lys Lys Val Val Ser Gln Thr Tyr Asp Phe Asp
        275                 280                 285

Lys Phe Thr Ile Asp Ser Ser Gln Arg Leu Asn Leu Ser Tyr Arg Tyr
    290                 295                 300

Val Phe Lys Asp Ser Lys Gly Lys Leu Ile Asn Ser Asp Asp Leu Gln
305                 310                 315                 320

Lys Gln Gly Tyr Ser Ile Thr Tyr Ile Asp Leu Cys Thr Val Ser Ile
                325                 330                 335

Lys Lys Gly Asn Ser Asn Glu Ile Val Lys Cys Asn
            340                 345
```

<210> 34
<211> 426
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene IV protein
      encoded by phage vector fpep3_1B-IR3seq (circular)

<400> 34

```
Met Lys Leu Leu Asn Val Ile Asn Phe Val Phe Leu Met Phe Val Ser
 1               5                  10                  15

Ser Ser Ser Phe Ala Gln Val Ile Glu Met Asn Asn Ser Pro Leu Arg
            20                  25                  30

Asp Phe Val Thr Trp Tyr Ser Lys Gln Thr Gly Glu Ser Val Ile Val
        35                  40                  45

Ser Pro Asp Val Lys Gly Thr Val Thr Val Tyr Ser Ser Asp Val Lys
    50                  55                  60

Pro Glu Asn Leu Arg Asn Phe Phe Ile Ser Val Leu Arg Ala Asn Asn
65                  70                  75                  80

Phe Asp Met Val Gly Ser Asn Pro Ser Ile Ile Gln Lys Tyr Asn Pro
                85                  90                  95

Asn Ser Gln Asp Tyr Ile Asp Glu Leu Pro Ser Ser Asp Ile Gln Glu
            100                 105                 110

Tyr Asp Asp Asn Ser Ala Pro Ser Gly Gly Phe Phe Val Pro Gln Asn
        115                 120                 125

Asp Asn Val Thr Gln Thr Phe Lys Ile Asn Asn Val Arg Ala Lys Asp
    130                 135                 140

Leu Ile Arg Val Val Glu Leu Phe Val Lys Ser Asn Thr Ser Lys Ser
```

```
145                      150                      155                      160

Ser Asn Val Leu Ser Val Asp Gly Ser Asn Leu Leu Val Val Ser Ala
                165                  170                  175

Pro Lys Asp Ile Leu Asp Asn Leu Pro Gln Phe Leu Ser Thr Val Asp
            180                  185                  190

Leu Pro Thr Asp Gln Ile Leu Ile Glu Gly Leu Ile Phe Glu Val Gln
        195                  200                  205

Gln Gly Asp Ala Leu Asp Phe Ser Phe Ala Ala Gly Ser Gln Arg Gly
    210                  215                  220

Thr Val Ala Gly Gly Val Asn Thr Asp Arg Leu Thr Ser Val Leu Ser
225                  230                  235                  240

Ser Ala Gly Gly Ser Phe Gly Ile Phe Asn Gly Asp Val Leu Gly Leu
            245                  250                  255

Ser Val Arg Ala Leu Lys Thr Asn Ser His Ser Lys Ile Leu Ser Val
        260                  265                  270

Pro Arg Ile Leu Thr Leu Ser Gly Gln Lys Gly Ser Ile Ser Val Gly
        275                  280                  285

Gln Asn Val Pro Phe Ile Thr Gly Arg Val Thr Gly Glu Ser Ala Asn
    290                  295                  300

Val Asn Asn Pro Phe Gln Thr Ile Glu Arg Gln Asn Val Gly Ile Ser
305                  310                  315                  320

Met Ser Val Phe Pro Val Ala Met Ala Gly Gly Asn Ile Val Leu Asp
            325                  330                  335

Ile Thr Ser Lys Ala Asp Ser Leu Ser Ser Ser Thr Gln Ala Ser Asp
            340                  345                  350

Val Ile Thr Asn Gln Arg Ser Ile Ala Thr Thr Val Asn Leu Arg Asp
        355                  360                  365

Gly Gln Thr Leu Leu Leu Gly Gly Leu Thr Asp Tyr Lys Asn Thr Ser
    370                  375                  380

Gln Asp Ser Gly Val Pro Phe Leu Ser Lys Ile Pro Leu Ile Gly Leu
385                  390                  395                  400

Leu Phe Ser Ser Arg Ser Asp Ser Asn Glu Glu Ser Thr Leu Tyr Val
            405                  410                  415

Leu Val Lys Ala Thr Ile Val Arg Ala Leu
            420                  425
```

```
<210> 35
<211> 410
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene II protein
      encoded by phage vector fpep3_1B-IR3seq (circular)

<400> 35
Met Ile Asp Met Leu Val Leu Arg Leu Pro Phe Ile Asp Ser Leu Val
```

```
          1                    5                         10                        15

          Cys Ser Arg Leu Ser Gly Asn Asp Leu Ile Ala Phe Leu Asp Leu Ser
                      20                  25                  30

          Lys Ile Ala Thr Leu Ser Gly Met Asn Leu Ser Ala Arg Thr Val Glu
                      35                  40                  45

          Tyr His Ile Asp Gly Asp Leu Thr Val Ser Gly Leu Ser His Pro Phe
              50                  55                  60

          Glu Ser Leu Pro Thr His Tyr Ser Gly Ile Ala Phe Lys Ile Tyr Glu
          65                  70                  75                  80

          Gly Ser Lys Asn Phe Tyr Pro Cys Val Glu Ile Lys Ala Ser Pro Ala
                          85                  90                  95

          Lys Val Leu Gln Gly His Asn Val Phe Gly Thr Thr Asp Leu Ala Leu
                      100                 105                 110

          Cys Ser Glu Ala Leu Leu Leu Asn Phe Ala Asn Ser Leu Pro Cys Leu
                      115                 120                 125

          Tyr Asp Leu Leu Asp Val Asn Ala Thr Thr Ile Ser Arg Ile Asp Ala
              130                 135                 140

          Thr Phe Ser Ala Arg Ala Pro Asn Glu Asn Ile Ala Lys Gln Val Ile
          145                 150                 155                 160

          Asp His Leu Arg Asn Val Ser Asn Gly Gln Thr Lys Ser Thr Arg Ser
                          165                 170                 175

          Gln Asn Trp Glu Ser Thr Val Thr Trp Asn Glu Thr Ser Arg His Arg
                      180                 185                 190

          Thr Leu Val Ala Tyr Leu Lys His Val Glu Leu Gln His Gln Ile Gln
                      195                 200                 205

          Gln Leu Ser Ser Lys Pro Ser Ala Lys Met Thr Ser Tyr Gln Lys Glu
              210                 215                 220

          Gln Leu Lys Val Leu Ser Asn Pro Asp Leu Leu Glu Phe Ala Ser Gly
          225                 230                 235                 240

          Leu Val Arg Phe Glu Ala Arg Ile Lys Thr Arg Tyr Leu Lys Ser Phe
                      245                 250                 255

          Gly Leu Pro Leu Asn Leu Phe Asp Ala Ile Arg Phe Ala Ser Asp Tyr
                      260                 265                 270

          Asn Ser Gln Gly Lys Asp Leu Ile Phe Asp Leu Trp Ser Phe Ser Phe
                      275                 280                 285

          Ser Glu Leu Phe Lys Ala Phe Glu Gly Asp Ser Met Asn Ile Tyr Asp
              290                 295                 300

          Asp Ser Ala Val Leu Asp Ala Ile Gln Ser Lys His Phe Thr Ile Thr
          305                 310                 315                 320

          Pro Ser Gly Lys Thr Ser Phe Ala Lys Ala Ser Arg Tyr Phe Cys Phe
                      325                 330                 335

          Tyr Arg Arg Leu Val Asn Glu Gly Tyr Asp Ser Val Ala Leu Thr Met
```

```
              340                    345                    350
Pro Arg Asn Ser Phe Trp Arg Tyr Val Ser Ala Leu Val Glu Cys Gly
        355                    360                    365

Ile Pro Lys Ser Gln Leu Met Asn Leu Ser Thr Cys Asn Asn Val Val
        370                    375                    380

Pro Leu Val Arg Phe Ile Asn Val Asp Phe Ser Ser Gln Arg Pro Asp
385                    390                    395                    400

Trp Tyr Asn Glu Pro Val Leu Lys Ile Ala
                    405                    410
```

<210> 36
<211> 111
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene X protein
      encoded by phage vector fpep3_1B-IR3seq (circular)

<400> 36
```
Met Asn Ile Tyr Asp Asp Ser Ala Val Leu Asp Ala Ile Gln Ser Lys
  1               5                  10                  15

His Phe Thr Ile Thr Pro Ser Gly Lys Thr Ser Phe Ala Lys Ala Ser
            20                  25                  30

Arg Tyr Phe Cys Phe Tyr Arg Arg Leu Val Asn Glu Gly Tyr Asp Ser
        35                  40                  45

Val Ala Leu Thr Met Pro Arg Asn Ser Phe Trp Arg Tyr Val Ser Ala
    50                  55                  60

Leu Val Glu Cys Gly Ile Pro Lys Ser Gln Leu Met Asn Leu Ser Thr
 65                  70                  75                  80

Cys Asn Asn Val Val Pro Leu Val Arg Phe Ile Asn Val Asp Phe Ser
                85                  90                  95

Ser Gln Arg Pro Asp Trp Tyr Asn Glu Pro Val Leu Lys Ile Ala
            100                  105                  110
```

<210> 37
<211> 87
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene V protein
      encoded by phage vector fpep3_1B-IR3seq (circular)

<400> 37
```
Met Ile Lys Val Glu Ile Lys Pro Ser Gln Ala Gln Phe Thr Thr Arg
  1               5                  10                  15

Ser Gly Val Ser Arg Gln Gly Lys Pro Tyr Ser Leu Asn Glu Gln Leu
            20                  25                  30

Cys Tyr Val Asp Leu Gly Asn Glu Tyr Pro Val Leu Val Lys Ile Thr
        35                  40                  45

Leu Asp Glu Gly Gln Pro Ala Tyr Ala Pro Gly Leu Tyr Thr Val His
    50                  55                  60
```

```
Leu Ser Ser Phe Lys Val Gly Gln Phe Gly Ser Leu Met Ile Asp Arg
65                  70                  75                  80

Leu Arg Leu Val Pro Ala Lys
                85
```

<210> 38
<211> 33
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene VII protein
      encoded by phage vector fpep3_1B-IR3seq (circular)

<400> 38
```
Met Glu Gln Val Ala Asp Phe Asp Thr Ile Tyr Gln Ala Met Ile Gln
 1               5                  10                  15

Ile Ser Val Val Leu Cys Phe Ala Leu Gly Ile Ile Ala Gly Gly Gln
            20                  25                  30

Arg
```

<210> 39
<211> 36
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene IX protein
      encoded by phage vector fpep3_1B-IR3seq (circular)

<400> 39
```
Met Ser Val Leu Val Tyr Ser Phe Ala Ser Phe Val Leu Gly Trp Cys
 1               5                  10                  15

Leu Arg Ser Gly Ile Thr Tyr Phe Thr Arg Leu Met Glu Thr Ser Ser
            20                  25                  30

Cys Val Ser Leu
            35
```

<210> 40
<211> 73
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: gene VIII protein
      encoded by phage vector fpep3_1B-IR3seq (circular)

<400> 40
```
Met Arg Lys Ser Leu Val Leu Lys Ala Ser Val Ala Val Ala Thr Leu
 1               5                  10                  15

Val Pro Met Leu Ser Phe Ala Ala Glu Gly Asp Asp Pro Ala Lys Ala
            20                  25                  30

Ala Phe Asp Ser Leu Gln Ala Ser Ala Thr Glu Tyr Ile Gly Tyr Ala
            35                  40                  45

Trp Ala Met Val Val Val Ile Val Gly Ala Thr Ile Gly Ile Lys Leu
    50                  55                  60

Phe Lys Lys Phe Thr Ser Lys Ala Ser
```

65   70

<210> 41
<211> 219
<212> PRT
<213> Artificial Sequence
<223> Description of Artificial Sequence: cat protein
      encoded by phage vector fpep3_1B-IR3seq (circular)

<400> 41
Met Glu Lys Lys Ile Thr Gly Tyr Thr Thr Val Asp Ile Ser Gln Trp
 1   5   10   15

His Arg Lys Glu His Phe Glu Ala Phe Gln Ser Val Ala Gln Cys Thr
            20   25   30

Tyr Asn Gln Thr Val Gln Leu Asp Ile Thr Ala Phe Leu Lys Thr Val
        35   40   45

Lys Lys Asn Lys His Lys Phe Tyr Pro Ala Phe Ile His Ile Leu Ala
    50   55   60

Arg Leu Met Asn Ala His Pro Glu Phe Arg Met Ala Met Lys Asp Gly
65   70   75   80

Glu Leu Val Ile Trp Asp Ser Val His Pro Cys Tyr Thr Val Phe His
            85   90   95

Glu Gln Thr Glu Thr Phe Ser Ser Leu Trp Ser Glu Tyr His Asp Asp
            100   105   110

Phe Arg Gln Phe Leu His Ile Tyr Ser Gln Asp Val Ala Cys Tyr Gly
        115   120   125

Glu Asn Leu Ala Tyr Phe Pro Lys Gly Phe Ile Glu Asn Met Phe Phe
    130   135   140

Val Ser Ala Asn Pro Trp Val Ser Phe Thr Ser Phe Asp Leu Asn Val
145   150   155   160

Ala Asn Met Asp Asn Phe Phe Ala Pro Val Phe Thr Met Gly Lys Tyr
            165   170   175

Tyr Thr Gln Gly Asp Lys Val Leu Met Pro Leu Ala Ile Gln Val His
        180   185   190

His Ala Val Cys Asp Gly Phe His Val Gly Arg Met Leu Asn Glu Leu
    195   200   205

Gln Gln Tyr Cys Asp Glu Trp Gln Gly Gly Ala
    210   215

<210> 42
<211> 238
<212> PRT
<213> Artificial Sequenc
<223> Description of Artificial Sequence: ompA-FLAG-peptide3-
      gene IIIs encoded by phage vector fpep3_1B-IR3seq (circular)

<400> 42
Met Lys Lys Thr Ala Ile Ala Ile Ala Val Ala Leu Ala Gly Phe Ala

```
      1                 5                 10                15

  Thr Val Ala Gln Ala Asp Tyr Lys Asp Val Asp Cys Ile Val Tyr His
              20          25                  30

  Ala His Tyr Leu Val Ala Lys Cys Gly Gly Gly Gly Ser Glu Phe Asn
          35          40              45

  Ala Gly Gly Gly Ser Gly Gly Gly Ser Gly Gly Gly Ser Glu Gly Gly
      50              55              60

  Gly Ser Glu Gly Gly Gly Ser Glu Gly Gly Gly Ser Glu Gly Gly Gly
  65              70              75              80

  Ser Gly Gly Gly Ser Gly Ser Gly Asp Phe Asp Tyr Glu Lys Met Ala
                  85              90              95

  Asn Ala Asn Lys Gly Ala Met Thr Glu Asn Ala Asp Glu Asn Ala Leu
              100             105             110

  Gln Ser Asp Ala Lys Gly Lys Leu Asp Ser Val Ala Thr Asp Tyr Gly
          115             120             125

  Ala Ala Ile Asp Gly Phe Ile Gly Asp Val Ser Gly Leu Ala Asn Gly
      130             135             140

  Asn Gly Ala Thr Gly Asp Phe Ala Gly Ser Asn Ser Gln Met Ala Gln
  145             150             155             160

  Val Gly Asp Gly Asp Asn Ser Pro Leu Met Asn Asn Phe Arg Gln Tyr
                  165             170             175

  Leu Pro Ser Leu Pro Gln Ser Val Glu Cys Arg Pro Phe Val Phe Gly
              180             185             190

  Ala Gly Lys Pro Tyr Glu Phe Ser Ile Asp Cys Asp Lys Ile Asn Leu
              195             200             205

  Phe Arg Gly Val Phe Ala Phe Leu Leu Tyr Val Ala Thr Phe Met Tyr
      210             215             220

  Val Phe Ser Thr Phe Ala Asn Ile Leu Arg Asn Lys Glu Ser
  225             230             235
```

<210> 43
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: primer FR604

<400> 43
gttcacgtag tgggccatcg   20

<210> 44
<211> 25
<212> DNA
<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: primer FR605

<400> 44
tgagaggtct aaaaaggcta tcagg   25

<210> 45
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: primer FR606

<400> 45
tagccttttt agacctctca aaaatag   27

<210> 46
<211> 19
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: primer FR607

<400> 46
cggtgtacag accaggcgc   19

<210> 47
<211> 39
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: DNA sequence encoding
     peptide pep3

<400> 47
tgtattgttt atcatgctca ttatcttgtt gctaagtgt   39

<210> 48
<211> 13
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: synthetic
     peptide pep3

<400> 48
Cys Ile Val Tyr His Ala His Tyr Leu Val Ala Lys Cys
  1   5   10

<210> 49
<211> 18
<212> DNA
<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: primer FR614

<400> 49
gctctagata acgagggc   18

<210> 50
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: primer FR627

<400> 50
cgcaagctta agactcctta ttacgc   26

≥IMATION

Fritz Rudert et al.   MORPHO/9

"Novel Method and Phage for the Identification
of Nucleic Acid Sequences Encoding Members of
a Multimeric (Poly) Peptide Complex"

Filed February 1, 2000; MS-DOS

PatentIn 2.0   Express Mail Label No.
                EI 187450224 US